Energy, Mines and Resources Canada | Énergie, Mines et Ressources Canada

CANMET

Canada Centre for Mineral and Energy Technology | Centre canadien de la technologie des minéraux et de l'énergie

WATERPROOFING A 32 mm DIAMETER TV BOREHOLE INSPECTION UNIT

G. Herget and F. Kapeller
Rock Mechanics Laboratory

JULY 1986

This document is an unedited internal report prepared primarily for discussion and internal publication purposes. It does not represent a final expression of the opinion of the Canada Centre for Mineral and Energy Technology (CANMET)

Ce document est un rapport provisoire non révisé et rédigé principalement pour [illegible] de discussion et de publication interne. Il ne représente nullement l'expression définitive de l'opinion du Centre canadien de la technologie des minéraux et de l'énergie (CANMET)

19pp

MINERAL AND ENERGY TECHNOLOGY
MINING RESEARCH LABORATORIES
DIVISION REPORT M&ET/MRL 86-92(TR)

MICROMEDIA

WATERPROOFING A 32 mm DIAMETER TV BOREHOLE INSPECTION UNIT

by

G. Herget* and F. Kapeller

SUMMARY

A portable 32 mm diam borehole television inspection unit had been developed in 1981 for roof inspection and borehole evaluation under contract.

A number of field tests indicated the great potential of the unit but also identified a number of areas which required modification to obtain a reliable exploration tool. These modifications involved the inclusion of a voltage limiter in the monitor to restrict power surges, the immobilization of the rotating mirror assembly and rebuilding the side viewing mirror and illumination system for waterproofing. Testing of the modified camera head in brine and in brine filled boreholes has shown that the introduced changes have been very effective.

KEYWORDS: Borehole exploration, TV camera, in situ investigation, borehole photography.

*Research Scientist, **Technician, Mining Research Laboratories, CANMET, Energy, Mines and Resources Canada, Ottawa.

IMPERMÉABILISATION D'UNE UNITÉ TÉLÉVISÉE D'INSPECTION D'UN DIAMÈTRE DE 32 mm POUR LES TROUS DE SONDAGE

par

G. Herget* et F. Kapeller**

SOMMAIRE

Une unité d'inspection télévisée portative d'un diamètre de 32 mm pour les trous de sondage a été développée lors d'un contrat en 1981 pour l'inspection des toits de mine et l'évaluation des trous de sondage.

Plusieurs tests in-situ ont montré le grand potentiel de cette unité, mais ils ont montré aussi que plusieurs sections requéraient des modifications pour obtenir un outil d'exploration efficace. Ces modifications ont impliqué l'inclusion d'un limiteur de voltage dans l'appareil de contrôle de façon à restreindre les surtensions, l'immobilisation du système de miroir rotatif et la reconstruction du miroir pour les vues de côté et du système d'illumination pour l'imperméabilisation. Utilisant cette caméra modifiée, des tests effectués dans l'eau salée et dans des trous de sondage remplis d'eau salée ont montré que ces changements furent très efficaces.

Mots-clés: Exploration des trous de sondage, caméra de télévision, investigations in-situ, photographies de trous de sondage.

*Chercheur scientifique, **technicien, Laboratoire de recherche minière, CANMET, Energie, Mines et Ressources Canada, Ottawa.

CONTENTS

	Page
SUMMARY	i
SOMMAIRE	iii
1. INTRODUCTION	1
2. MODIFICATION OF ST 6-CAMERA HEAD	1
3. PERFORMANCE EVALUATION	3
4. ACKNOWLEDGEMENTS	3
5. REFERENCE	3

FIGURES

No.		
1.	Lamp assembly	4
2.	Cross-section of lamp assembly	5
3.	Connector ring (A) and lens head connection	6
4.	Pyrex glass tube (A) and mirror assembly	7
5.	Lamp holder plug	8
6.	Stainless steel cover	9
7.	End plug for camera head	10

1. INTRODUCTION

A TV borehole inspection unit (St-6 Camera) suitable for inspecting ground conditions in small boreholes was built by Arvin Diamond of Ohio/USA and purchased through their Canadian distributor in 1981.

This equipment is very portable (two 13 kg units) and provides a magnified high resolution black and white television picture of the side wall of a borehole. The camera is equipped with a 38 m and a 150 m cable.

During field work the camera showed significant potential as an exploration tool but difficulties arose in a number of areas:

1. rotating mirror changed image to upside down,
2. mirror motor operated intermittently,
3. light source operated unreliably,
4. exposed light bulb broke easily on contact with water,
5. slip ring contacts behind camera lens were unreliable,
6. feed through lens contacts were unreliable,
7. electrical contacts between lens assembly and mirror motor were unreliable,
8. printed circuit short circuited in a hostile environment or during rough handling,
9. voltage regulator was destroyed when short circuited,
10. view obstructed by camera head housing.

The report below describes the modifications which were carried out to significantly improve the performance of the camera.

2. MODIFICATIONS OF THE ST6-CAMERA HEAD

The custom built rotating mirror assembly which allows side viewing of borehole walls works perfectly if the mirror and the TV camera are lined up in a particular orientation. When the mirror is allowed to rotate, however, alignment is lost. The reference point changes continuously during rotation and picture orientation is difficult. For viewing the side wall of a borehole, it is therefore better to fix the position of the mirror assembly with respect to the camera's position, and rotate both as a single unit. This can be done by rotating together the camera head assembly with the installing rods in the drillhole.

With the immobilization of the rotating mirror assemblies, the rotating slip rings between the Videcon tube and the lens assembly could be replaced by flexible wires. To protect the circuits from any possible currents due to a possible shorting out of the lighting systems in the future, a constant current limiter was installed in line between the voltage supply and the lamp.

The next step was to completely rebuild the lens assembly to permit waterproofing all circuitry. This required a replacement of the original lamp (28V, 25W) by a lower wattage lamp. A new miniature halogen lamp was selected as a replacement (Sylvania No. 2011 with 12 V, 12 W). This lamp permitted design and fabrication of the fully enclosed lamp assembly shown in Fig. 1 and 2. This assembly is connected to the camera head by a newly cut 20 TPI thread. The new assembly is described below:

NEW LAMP ASSEMBLY

When assembling the unit, two 15 cm (6 in.) long Teflon insulated wires are soldered to the appropriate solder points. The solder joints must be checked to ensure that no short occurs, when the connector ring (Fig. 3) is screwed on. These two joints should be covered with an insulating lacquer.

Then the proper size o-ring is placed on the lens assembly and the connector ring is screwed to the lens assembly. The supply voltage to the lamp should be checked. Following this a suitable o-ring is placed on the end of the connector ring and the Pyrex glass tube (Fig. 4(A)), with the two wires on the inside pushed against it (Fig. 1).

The mirror assembly (Fig. 4(B)) with the mirror facing the lens is slid into the glass tube with the two wires between glass and the outside diameter of the assembly. The two wires are fed through the 1/4 in. hole. The wires are cut to length and soldered onto the lamp socket. The lamp is inserted into the socket, observing precautions required for the installation of Halogen lamps.

Another o-ring is placed over the mirror assembly and allowed to protrude about 1/2 in. out of the glass tube. The lamp socket is fastened with a 2-56 machine screw to the lamp holder plug (Fig. 5) and inserted into the mirror assembly. The wires are placed behind the mirror and a 4-40 flathead machine screw is installed.

With the monitor switched on, a picture (e.g., printed text) is produced on the screen. By turning the mirror relative to the Videcon tube, the picture is adjusted until the required object orientation is achieved. The stainless steel tube (Fig. 6) is slipped over the whole assembly and screwed onto the connector ring, until the mirror is located in the centre of the window. The rubber grommet is placed on the backside of the lamp holder plug and the end plug is screwed into the sleeve as shown in Fig. 7. The glass should not move when the screws are tight. Slight adjustments may be necessary for final alignment of the picture and to prevent connecting wires from obstructing the camera's view. O-rings should have a light coating of vacuum grease. Finally, the assembly is checked for leaks by immersion in water.

3. PERFORMANCE EVALUATION

Use of the original TV-camera equipment in a number of underground mines had proved its inability to cope reliably with the hostile environments involved.

After rebuilding of the camera head and introducing the necessary circuit modifications, the camera head was operated for six hours submerged in a brine solution. All camera functions were normal after six hours. The camera was then shipped to Potash Company of America, Saskatoon for use in boreholes as part of a geotechnical investigation program. The camera head and the monitor worked without problems in this rather hostile environment.

ACKNOWLEDGEMENTS

The drawings were prepared by J. Folta.

REFERENCE

Arvin Diamond, 1981. Model St-6 Camera Instruction Manual, 117 p.

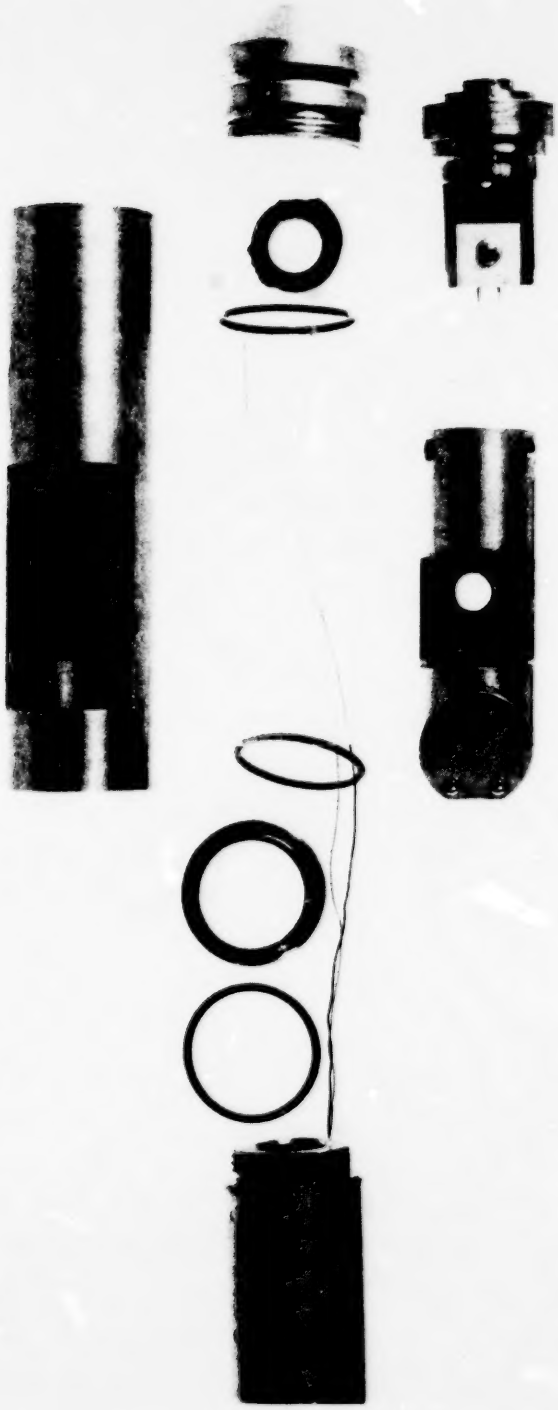


Fig. 1 - Lamp assembly.

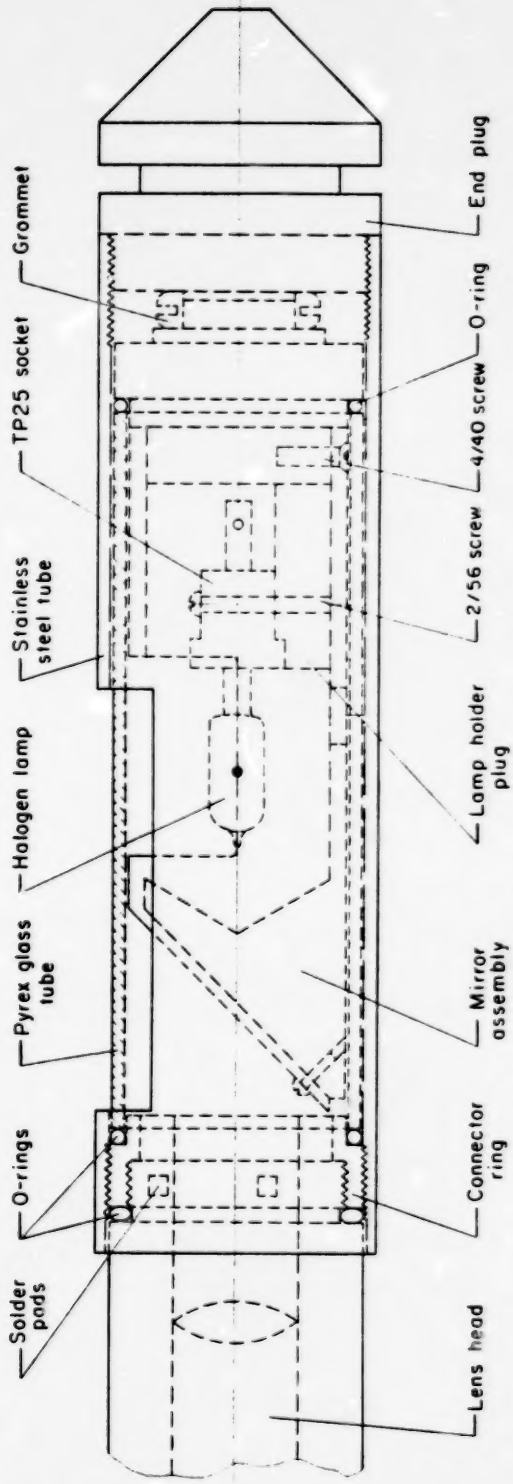
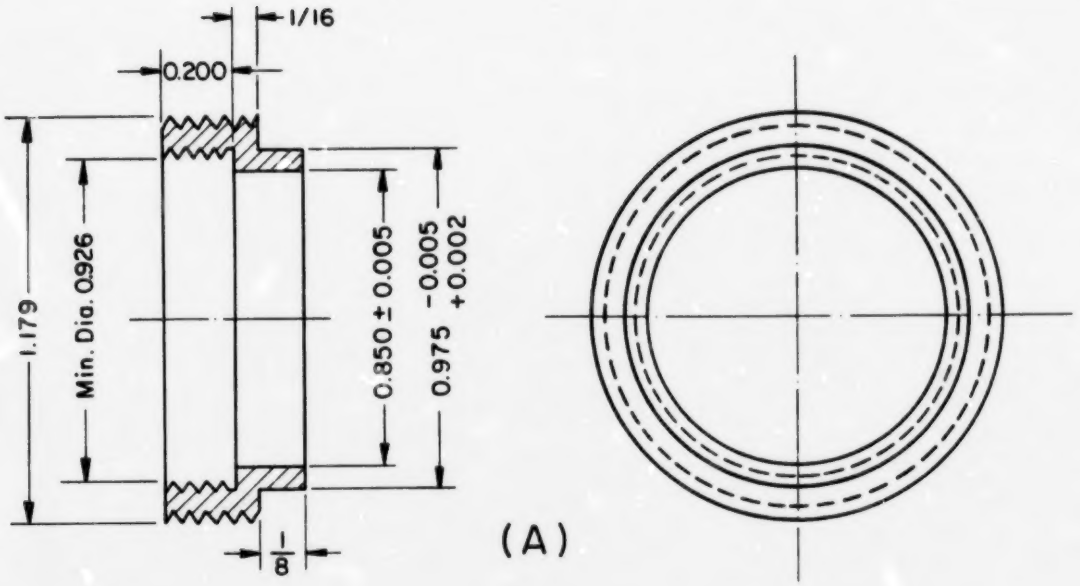


Fig. 2 - Cross-section of lamp assembly.



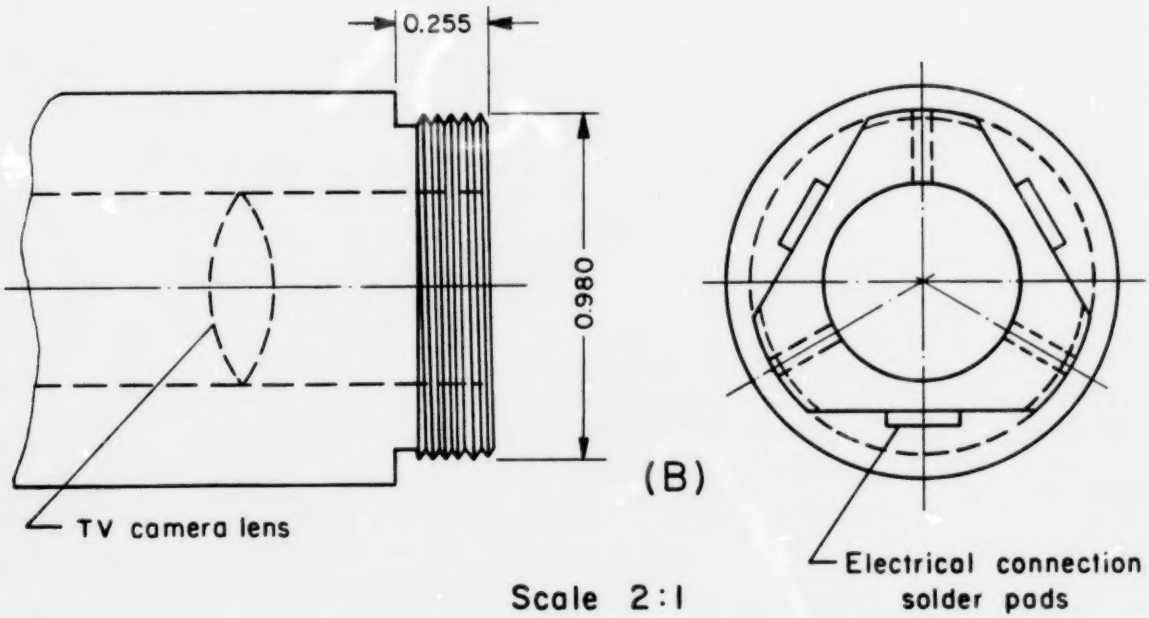
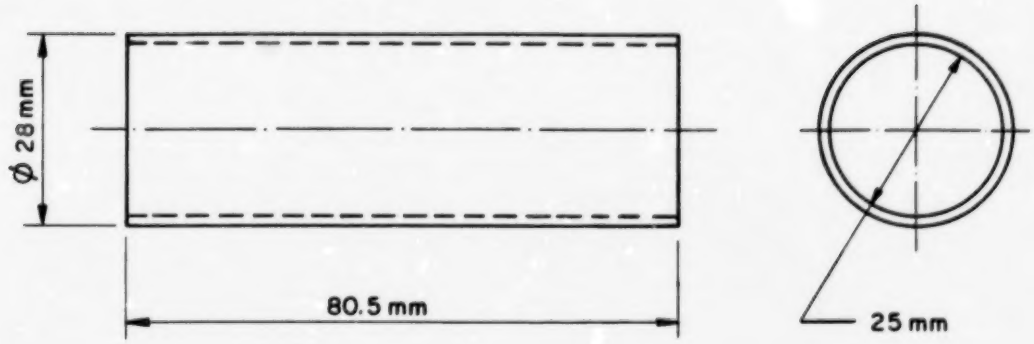
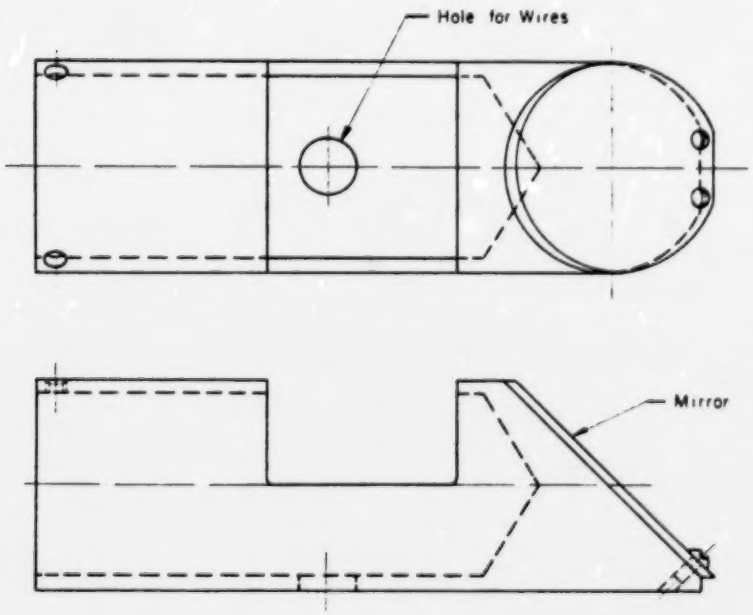


Fig. 3 - Connector ring (A) and lens head connection.



Scale 1:1

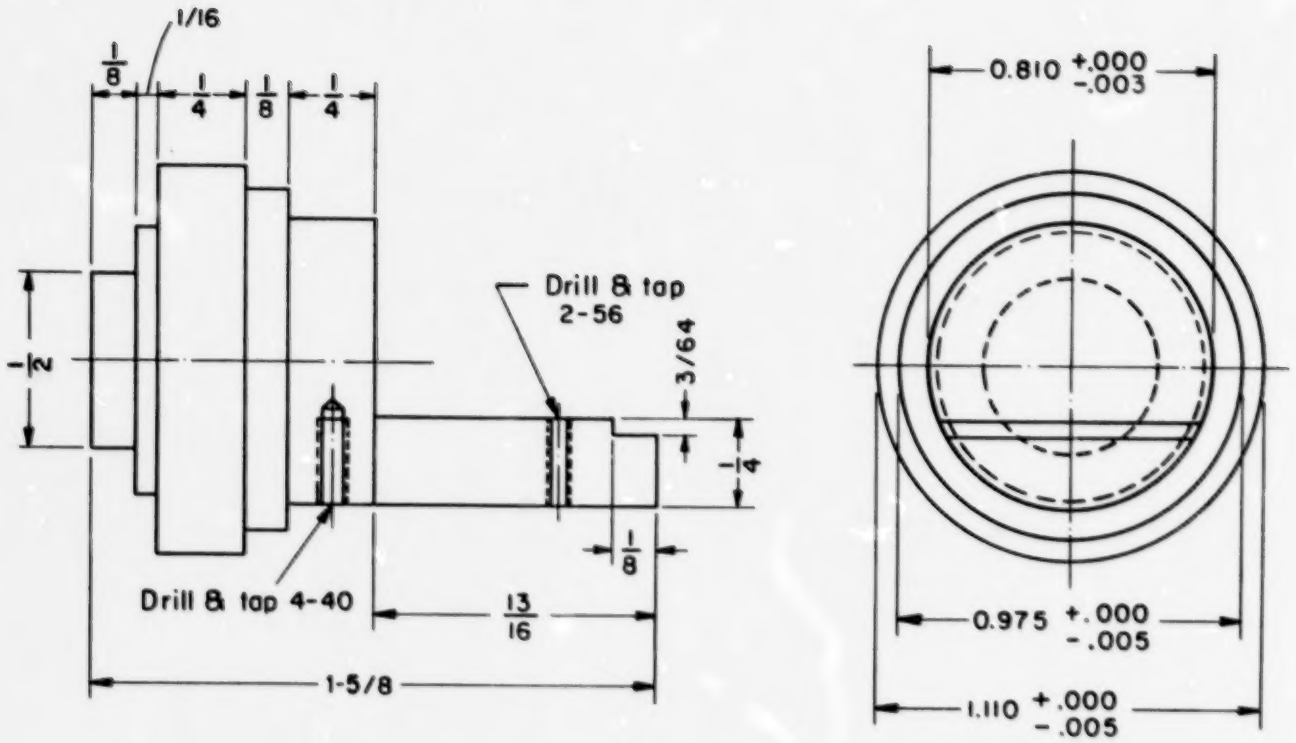
(A) Material: Standard pyrex glass tube.
Cut to length and grind both ends smooth



(B)

Scale 2:1

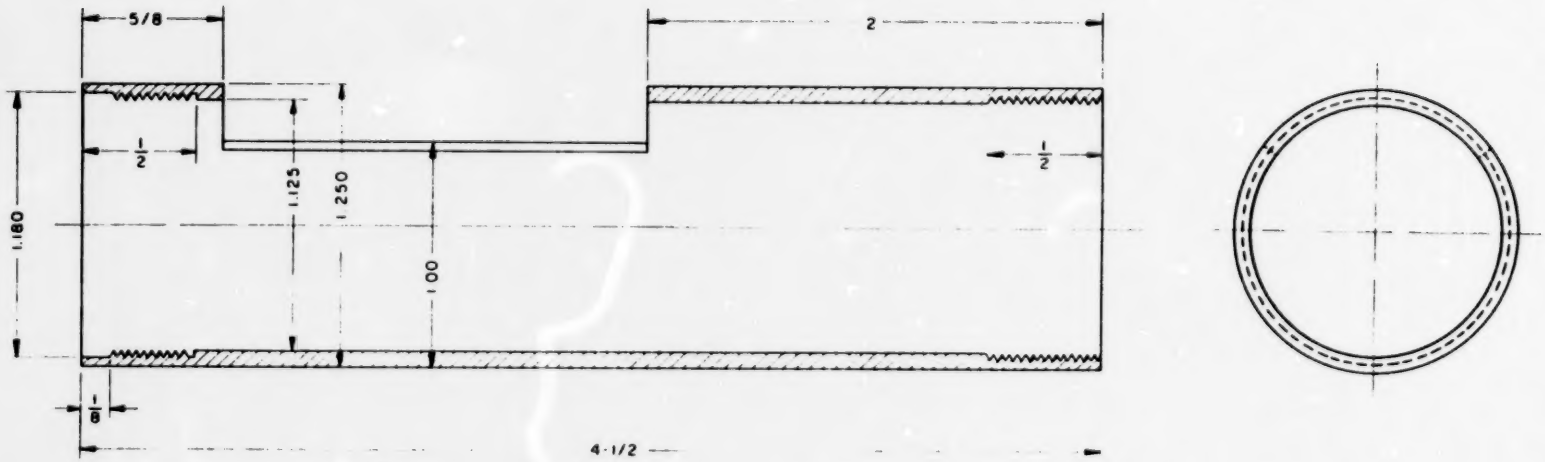
Fig. 4 - Pyrex glass tube (A) and mirror assembly.



Material: Stainless Steel

Scale 2:1

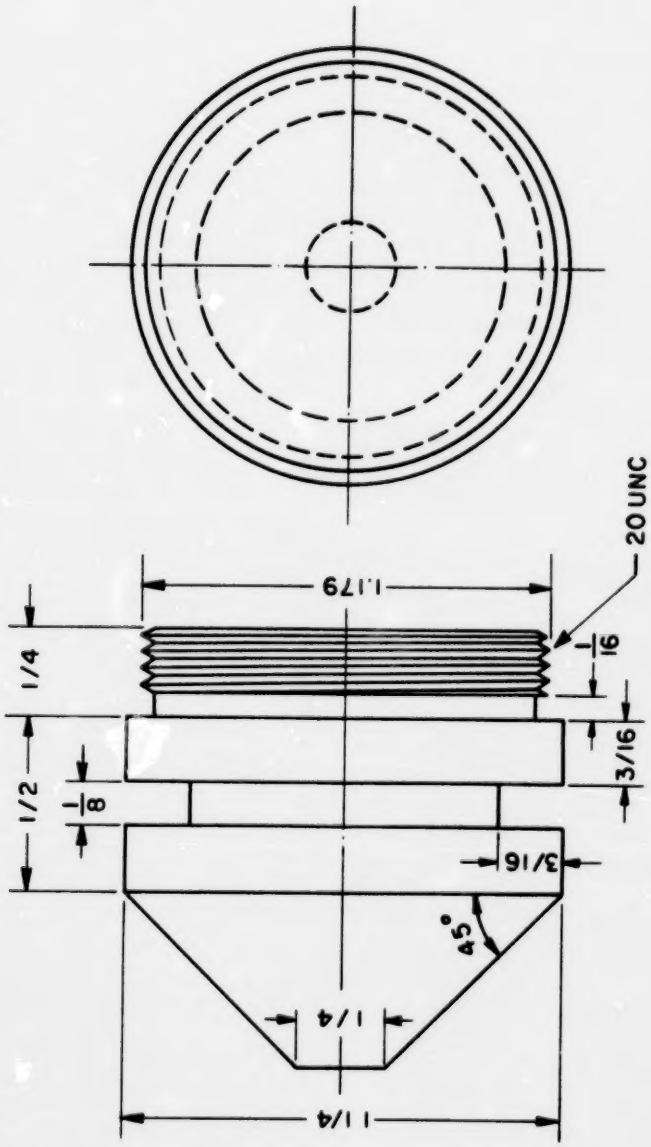
Fig. 5 - Lamp holder plug.



Material: Stainless Steel
Thread: 20UNC

Scale 2:1

Fig. 6 - Stainless steel cover.



Material: Stainless Steel Scale 2:1

Fig. 7 - End plug for camera head.